

A REVISION OF THE RABBIT-BANDICOOTS.

Family PERAMELIDAE, Genus *Macrotis*.By ELLIS LE G. TROUGHTON.*
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In view of the consistent omission of New South Wales from the range of the rabbit-bandicoots, in which recent authors appear to have followed the British Museum Catalogue of 1888, I assembled the Australian Museum material several years ago with the intention of identifying the local race and recording various localities within the State; notes were made, but pressure of routine made it impossible to complete the work. The rapid shrinkage in the range of the local form is relevant to my current Presidential Address, and, as the characteristics of the race should be available for co-workers, it is proposed to deal with them in relation to allied forms, after tracing some early records, and stabilising the generic name.

It is surprising that though Reid described the first rabbit-bandicoot in 1837, wrongly localised as Tasmania and actually from south Western Australia, their occurrence in New South Wales was apparently not recorded until 1864, in Krefft's "Catalogue of the Mammalia in the Australian Museum." In this first reference, Krefft listed an adult female from the Lower Murray, gave the name used by aborigines of the Lower Darling as "Jacko," and included the "interior of New South Wales" in the habitat. In 1866, his paper on "The Vertebrates of the Lower Murray and Darling" (1), reiterated the aborigines' names as "Wuirrapur (Murray natives)," and "Jecko (Darling tribes)," and stated that "This beautiful animal, like many other species, has long ago retreated to the north of the Murray." The first edition of his "Australian Vertebrata" (2) gives the range as "principally the plains of the interior, from the Lower Lachlan and Murrumbidgee to West Australia." In the second edition Krefft (3) refers to fossil remains of living species of *Perameles* being taken at Wellington [caves], New South Wales, and states that "A few remains of the *Peragalea* were also obtained; the teeth are larger and slightly different from the *Peragalea lagotis* of the present day." In his "Mammals of Australia," also of 1871, the habitat was given as "New South Wales, Northern Victoria, South Australia, Queensland, and West Australia."

The listing by Lydekker in 1887 of portions of a maxilla and mandible in the British Museum, with molars in situ, "from a cave in the Wellington Valley," apparently provides the only other authentic record of rabbit-bandicoots in New South Wales; the material was "Presented by the Trustees of the Australian Museum, 1870," and probably represented the "remains" referred to by Krefft of which, unfortunately, nothing seems to have been retained for our Museum. The habitat of "*Peragale lagotis*" was given by Lydekker as "Western Australia (recent), and New South Wales (pleistocene)," which may have led Thomas to suppose that the rabbit-bandicoot was no longer living in the eastern State, thus possibly

* Contribution from the Australian Museum.

(1) Krefft, Trans. Phil. Soc. N.S.W., 1862-1865 (1866), 14.

(2) Krefft, Cat. Nat. Industr. Prod. N.S.W., 1867, in Offic. Rec. Intercol. Exhib. Melbourne, 1867, appendix, 405 (57).

(3) Krefft, Industr. Progress of N.S.W. (Rept. Intercol. Exhib. 1870), iii., 1871, 21.

explaining his action in the "Catalogue," where the habitat was given as "South and West Australia" only, although he listed two of Krefft's references, as well as Lydekker. This omission of the eastern State misled subsequent authors, and so we find New South Wales excluded from the range of the genus by Ogilby in his Catalogue of 1892, Baldwin Spencer in the Horn Report of 1896, and all systematic and popular works.

It was indeed unfortunate that Ogilby, a brilliant ichthyologist, should have been commissioned to prepare the "Catalogue of Australian Mammals," issued by the Australian Museum. He evidently made a mere compilation without reference to the fascinating collection already in the Museum, thus providing an excellent example of the need for specialisation, which has since become an essential part of museum practice. The omission of local records by Ogilby is rendered more surprising by the fact that in the year preceding his Catalogue a splendid adult male rabbit-bandicoot was received from Bathurst, about 100 miles west of Sydney, presented by Dr. Machattie in September, 1891; other material then in the collection included skulls and skeletons from "Moolah," Mossgiel, presented by the owner of the property, Mr. K. H. Bennett, in 1879-1880, a skin and skull of a female from Coombie, collected by Messrs. Bennett and Adam in 1883, and another complete specimen from Illabo, between Cootamundra and Junee Junction, in 1886.

Since 1892, fifteen specimens reached the Museum, making in all at least twenty-two, of which the last was received from Moree in June, 1908; though several are not definitely localised, there is no doubt that the entire series came from within New South Wales. Fortunately, only three specimens have been exchanged abroad, leaving series of nine skins and sixteen crania for examination. Probably never very plentiful, the rabbit-bandicoot was apparently distributed fairly evenly west of the dividing range in the early days, and, unless mere coincidence, appears to have been more abundant in some years as three specimens reached the Museum in August, 1897, and again in 1903. There seems no doubt, however, that the local race has vanished from the more settled areas, and that, as Wood Jones found in South Australia, the Bilby is rapidly disappearing from New South Wales, or is at least faced with a precarious existence in more desert regions. I am not aware of pelts ever having been marketed to any extent in Sydney, as at the skin sales in Adelaide, but no doubt numbers have been killed in rabbit traps, and wantonly for so-called sport, while foxes must be contributing to the apparent annihilation within New South Wales.

The last record of the Bilby's occurrence in New South Wales, so far as I am aware, is provided by my colleague, Mr. K. C. McKeown, who had a pair under close observation in the rocky hills on the Wagga Experimental Farm for about five years prior to 1912, when they were unfortunately slaughtered by shooters from the town, to the intense regret of his father, then manager of the farm. The number never seemed to increase, only two ever being seen, which probably lived in crevices or shared the rabbit warrens amongst the rocks. According to Mr. McKeown, they were not very shy and were about at almost any time during the day; he adds that during a long association with the Murrumbidgee Irrigation Area he never saw a Bilby on or near that area, which would appear to have been a stronghold for them in the past.

In stating that there certainly is no part of South Australia in which the Bilby is not a rapidly disappearing animal, Wood Jones expresses sur-

prise at the decrease of numbers in the centre, where the animal is little molested by man and where he considers the fox to be still absent or rare, and suggests that the great abundance of rabbits and resultant struggle for breeding burrows may be responsible. My own experience when collecting in very dry country about Farina, South Australia, in 1919, was that foxes were very numerous and already tending towards a small lean desert type capable of entering the larger rabbit burrows without difficulty, and doubtless those of the Bilbies as well.

Krefft referred to the rabbit-bandicoot as not being gregarious, a pair only occupying a burrow, and to having procured but a few, amongst which was a female with two large young in the pouch. According to Wood Jones, one or two constitutes the usual litter, although there are eight teats, and it seems possible that a reduced rate of breeding, in the less hospitable regions to which settlement is forcing them, where the cunning introduced enemy probably now abounds, must ultimately lead to the extinction of this harmless, picturesque, and pest-destroying marsupial.

In his comprehensive "Review of the Rabbit-Bandicoots," afterwards included in the "Handbook," Wood Jones described a new species, *Thalacomys nigripes*, and originated cranial features to differentiate the known forms. Emphasising the need for large series in determining specific characters of mammals, he referred to the recognised variability of animals inhabiting the more central regions, and to the possibility that further material might invalidate some of the conclusions, which were thus tentative in some respects. As forecasted, examination of sixteen crania from New South Wales show the cranial features relied on to be variable beyond a degree of specific value in races intergrading in size.

In regard to the extraordinary variability which renders characterisation of the large races especially difficult, consideration of the wide range accorded some forms in relation to the various types of country shown on the recent C.S.I.R. vegetation map (4) suggests that much of the variation, particularly in size, represents natural reaction to environment. The shrinkage in the range of once widely distributed forms is apparently evolving distinctive geographical races, which will become more marked with isolation in the unlikely event of survival under the prejudicial conditions of to-day.

The New South Wales series appears to represent a geographical race of *lagotis*, and a thorough comparison with typical western and intermediate material invokes drastic rearrangement of the larger forms of the genus. In offering the following conclusions, based upon intergradations of character and range, full acknowledgment is made to Professor Wood Jones for so admirably reviewing and figuring the known forms against the time when additional material should be available.

It is not practicable to summarise Professor Wood Jones' thorough account of the bionomics of the genus, beyond emphasising that the ones observed were far more carnivorous than any other bandicoots (*Isodon* or *Perameles*) that he had studied in captivity. The Professor also stated that the tolerance shown towards the Bilbies by early colonists was due to recognition of the fact that in the destruction of mice and insects, rabbit-bandicoots were very useful animals. In this regard alone, it is indeed unfortunate that the depredations of the introduced fox, the poison-cart, and

(4) Prescott, Council Sci. Ind. Research, Bull., No. 52, 1931.

the actions of thoughtless or ill-informed people, should have swept this interesting and useful creature from the settled areas of New South Wales.

It is considered advisable to review the complicated synonymy at length as some indication of the immense amount of taxonomic work to be done towards stabilising many mammal names. In doing so, I wish to acknowledge indebtedness to Mr. Tom Iredale for his helpful advice; also to Mr. G. P. Whitley, who kindly prepared the distribution map. Sincere thanks are due to both colleagues for that ever-ready exchange of views which is the very essence of the stimulating and pleasant side of museum research.

Genus MACROTIS.

1837. *Macrotis* Reid, Proc. Zool. Soc., 131 (Ot. *Perameles lagotis* Reid).
 1838. *Thylacomys* Owen, Athenaeum, London, No. 572, Oct. 13, 747 (n. n.).
 1840. *Thalacomys* (err. pro *Thylacomys* Owen), Blyth, Cuvier's Anim. Kingd., 104 (teste Palmer). Haplotype *Macrotis lagotis* (Reid).
 1841. *Paragalia* Gray, in Grey, Journ. Two Exped. Austr., app. ii., 401. Haplotype *Macrotis lagotis* (Reid).
 1843. *Perigalea* Gray, List. Mamm. Brit. Mus., xxii.
 1843. *Paragalea* Gray, *ibid.*, 96. and as "Peragalea" (vernacular only).
 1845. *Peragalea* Gould, Mamm. Austr., pt. 1, pl. xii (vide Waterhouse), also vol. i., pl. vii. (bound), ex Gray, 1843 (vernacular).
 1846. *Macrotis* Waterhouse, Nat. Hist. Mamm., i., 358 (*Peragalea* Gray cited, p. 360).
 1854. *Phalacomys* (wording ex Blyth-Cuvier), English Cyclopaedia, Nat. Hist., i., 382. Typographical error only.
 1887. *Macrotis* Jentink, Cat. Ost. Leyden Mus., 305.
 1887. *Peragale* Thomas, Ann. Mag. Nat. Hist. (5), xix., 397-9; Id., Lydekker, Cat. Foss. Mamm. B.M., pt. v., 1887, 256; Id., Thomas, Cat. Mars. Monotr. B.M., 1888, 221; Id., Waite, Ann. Mag. Nat. Hist. (7), ii., 1898, 196 (note).
 1899. *Thylacomys* Palmer, Ann. Mag. Nat. Hist. (7), iv., 300-2.
 1900. *Thalacomys* Thomas, *ibid.*, v., 223 (note).
 1904. *Macrotis* Palmer, Index Gen. Mamm., 394-5 ("preoccupied by *Macrotis* Dejean").
 1904. *Paragalia* Palmer, *ibid.*, 513 ("antedated by *Thylacomys* Owen").
 1904. *Thylacomys* Palmer, *ibid.*, 677.
 1906. *Thalacomys* Thomas, Proc. Zool. Soc., 475 (footnote).
 1907. *Thylacomys* Elliot, Publ. Field. Col. Mus., Zool. Ser., viii., 10.
 1923. *Thalacomys* Wood Jones, Rec. South Austr. Mus., ii., 3, 339, and Handbook Mamm. South Austr., pt. 2, 1924, 152.

History and Synonymy.—The generic name of the rabbit-bandicoots has probably been subject to more confusion than that of most marsupials, and, as the comments of such eminent authors as T. S. Palmer and the late Oldfield Thomas left an invalid name in use, it seems desirable to traverse the complicated history with a view to stabilising the authentic name for this interesting genus.

In 1837, Reid, when describing *Perameles lagotis*, provided the sub-genus *Macrotis* in view of the marked distinction between it and the other species of *Perameles*. These differences were emphasised by Owen (1838, P.Z.S.) in comparison with other forms, in which the name *Perameles* was employed throughout, but a new generic name had been proposed during

the reading for the rabbit-bandicoot, which was made clear by a brief report in the London Athenaeum, stating that Mr. Owen "proposed the new genus *Thylacomys* for certain species presenting a peculiar conformation of the cranium." The name was carefully omitted from the published work, but Owen evidently overlooked the formal press report of the Zoological Society's meeting, and there is no doubt that *lagotis* was the form referred to.

In 1840, Blyth used *Thalacomys* on the authority of Owen, and, though this was a misprint for the *nomen nudum* of the Athenaeum, Thomas (1900) utilised Blyth's spelling and later disagreed with Palmer's (1904) objection that it was an "obvious misprint." Thomas argued (1907) that we are not justified in calling *Thalacomys* a misprint when it was the second name occurring, as if corrected, and "was again twice repeated by its author in subsequent editions." The value of these arguments, however, is nullified by the facts that "*Thyla*" (pouch) was frequently used in combinations of marsupial names by Owen, whom Blyth was quoting, and that the several editions of Blyth's work were stereotyped, so that repetition had no significance whatever. On checking back the English Cyclopaedia (1854), Mr. Iredale found the name printed *Phalacomys*, another misprint, and actually the second time the name had been independently published.

In 1841, Gray introduced the name *Paragalìa*, which has been subjected to far greater varieties of spelling than Owen's debated name, and which was actually started by Gray himself in 1843, when in one work he provided the vernacular name "Peragalea," and twice spelt his generic name differently to its original form.

Gould (1845), utilising the vernacular "*Peragalea*" generically, refers to *Macrotis*, but after remarking that Reid minutely described the dental and external characters of *Perameles lagotis*, which were considered by him to be typical of a distinct genus, Gould then surprisingly states that "he did not, however, publish any generic characters," and adopts Gray's name for the rather fantastic reason that "the term *Macrotis* is objectionable from its similarity to the specific name."

In 1846, Waterhouse cites Gould's work, but gives *Macrotis* priority as a subgenus of *Perameles*, after which the name lapsed from general use, due rather to Gould's action than, as suggested by Palmer, to the later supposition than Dejean's Coleopteran name invalidated it.

In his Catalogue (1888) Thomas quoted the vernacular name *Peragalea* as Gray's generic one, and wrongly referred it to Gray's original reference for *Paragalìa*. In 1887, Thomas had amended the vernacular name to *Peragale*, and, in a footnote in the Catalogue to support its use, throws doubt on the existence of Owen's *Thylacomys* by the erroneous suggestion that Blyth's version of it was based upon a confused account of Gray's *Thylamys* = *Didelphys*, for an American opossum. The name *Peragale* was then employed until the use of *Thylacomys* by Waite for a rodent led to conflict of opinion between Palmer and Thomas on the relative merits of Owen's and Blyth's names, in which the claims of *Macrotis* were overlooked on the supposition that previous use in entomology by Dejean (1833) rendered it untenable.

Though I am unable to examine Dejean's first edition, Sherborn (5) states his *Macrotis* to be a *nomen nudum*, a view which has the con-

(5) Sherborn, Index Animalium (2), xv., 1928, 3777.

currence of Iredale, who has seen the work, while the name is not in use amongst Coleopterists, and apparently never has been accepted by them. Reference to the third edition (1837), in the library of the Linnean Society of New South Wales, clearly demonstrates that *Macrotis* Dejean is a *nomen nudum*. In view of the invalidity of Dejean's name there appears to be no doubt that *Macrotis* of Reid is the correct generic name for the rabbit-bandicoots of the family *Peramelidae*.

Review of Diagnostic Characters and Geographical Range.

Cranial Characters.—The main ones figured and tabulated in his summary by Wood Jones are (1) the relative extension of the hind margin of the palate in relation to M4, (2) size and position of the palatal vacuities in relation to the dentition, and (3) the extension of the nasalia posteriorly in relation to a line joining the lachrymal foramina.

(1) The extension of the palate beyond the last molar is not so marked in the local specimens, or my Western Australian skulls, as in the South Australian one figured by Wood Jones, and, though it may be a characteristic of the *Nalpa* skulls, the local series shows the feature to be variable and subject to growth change; several young females have the palate terminating at M4, as figured for *sagitta*, suggesting that the feature may be misleading in a small series. However, the distance between molar and palate-end is well-marked in an aged male of the local series, the distance being almost equal to that figured by Wood Jones.

(2) The relative position and size of the palatal vacuities is very variable. In seven skulls with basal lengths from 80.5-88 mm., including two females, one of which is aged, the hind edge does not surpass the anterior border of M3; in nine others ranging from 87.5-96 mm., males and females, the rear margins just surpass the front edge of M3, and in only one of the sixteen crania does the condition almost exactly approximate that regarded as typical of *lagotis*, in which the hind margin is in line with the mid-point of M3. The anterior margin of the vacuities varies in origin from the front edge to the middle of Pm3, the vacuities being exceptionally long in some individuals.

(3) The nasalia are strikingly variable in the sixteen crania, both in contour and width, and particularly in the relation of the hind edge to the inter-lachrymal line, showing the character to be quite unstable as a diagnostic one in regard to the various races. In a fully adult Western Australian male the nasals do not approach the line as closely as figured by Wood Jones, while an adult female from the same locality shows a space of 4 mm., thus equalling the condition figured for *nigripes*. In the sixteen New South Wales crania only four have the nasal margin almost touching the inter-lachrymal line, figured as typical of *lagotis*, while in the rest the dividing space ranges from 2-4 mm.; that any phase is not typical of either sex, or the eastern or western forms, is shown by the fact that in two adult (N.S.W.) males of similar palate length one has the nasals almost in contact with the line between the foramina, the other an intervening space of 4 mm., as in the Western Australian female. It is thus clear that the feature is not of diagnostic value.

Cranial variation embracing two characters dealt with above is found in a young adult, basal length 83 mm., which has the nasals almost touching the inter-lachrymal line, as shown for *lagotis*, and the palate terminating at M4, as given for *sagitta*; this palatal condition in New South

Wales specimens certainly seems to be due to age, but it suggests the possibility that aged specimens of *sagitta*, if long series were available, might show the reverse condition, tending to intergradation.

The crescentic molar rows, said to be typical of *lagotis*, in which the palate is rounded posteriorly, appear to be accentuated by age, owing to the splaying outward of the molars, the resultant pressure considerably increasing the breadth outside M3. Growth to the aged condition produces a striking change in the molars; with growth upwards and wear, the length of the inner edge is reduced and its median notch disappears, while the whole tooth is greatly expanded outwards. The extent of this change is well shown by a young adult and aged female (N.S.W.) of similar basal length, in which the transverse width of M2 is 4.8 and 7.2 respectively, and the width outside M3 is 24.2 against 28.8 mm.

External Characters.—In the composite *lagotis*, unfortunately, the neutral body coloration provides no definable features to characterise the various races, leaving the relative extent of the black and white of the tail, and the dark hairing of the sole, except in *nigripes*, as the only and very variable colour characters. The proportions of the black and white areas of the tail are rendered unstable, both by natural variation and the secondary factor that the length of the hairs beyond the actual tip is especially variable and affected by wear, thus nullifying the diagnostic value of the feature in *lagotis*. In *minor*, however, restriction of the black hairs to a dorsal band, instead of an encircling one, differentiates the species from the small races of *lagotis*, while the wholly white tail of *leucura* is unique in the genus.

The coloration of the pes appears to supply a diagnostic external feature, in so far as whiteness above and below characterised the holotype of *leucura*, and the blackness *nigripes*, but the use of the mere relative extent of the dark mark on the sole to differentiate *lagotis* and *sagitta*, both having the pes white above, is not justified. The instability of the dark sole-mark is further shown in that the specifically distinct *minor* has the pes-coloration agreeing with that of *lagotis*.

It may be noted that Thomas regarded the black sole-mark as variable, stating in the Catalogue that the soles were "white distally, but the latter colour replaced by black in very old specimens." The feature is certainly very variable as a pair from Rawlinna, Trans-Australian Railway, shows the male with the blackish hairs continuing to the large pad, as in my local and South-west Australian specimens of *lagotis*, while in the female the dark line is very slight, though extending for more than the posterior third, said to be typical of *sagitta*. The relative extent of the dark sole-mark is therefore too slight and variable for use as a diagnostic character.

The naked area extending backward from the rhinarium is an obviously variable feature in *lagotis*, caused by thrusting or rooting in the ground for food, so that its relative extent is not of diagnostic value. Its absence, however, in *leucura* and Spencer's series of *minor*, supported by other differential characters, suggests a difference in habits in the two smaller species.

Geographical Range.—Regarding *lagotis*, Wood Jones has corrected the inference to be drawn from Thomas' 1905 paper that the species was restricted to Western Australia, pointing out that it was the familiar species of Bilby in the more fertile areas of South Australia a comparatively short time ago. The habitat of *sagitta*, according to Wood Jones, could not be considered typically South Australian, but as representing the genus in the more arid central region, the view therefore being that the range of the

two species did not overlap. The specimen recorded by Finlayson (6) from near the Musgrave Ranges as *lagotis* seemed to conflict with the idea that the typical western form was absent from the more central region. Later, the same author (*ibid.*, lv., 1931, 161) records specimens of *Thalacomys lagotis* from 120 and 150 miles north-east and north-west of Alice Springs respectively, and withdraws his suggestion, founded on the Musgrave Range female, that the Central *lagotis* is a dwarfed form. As Finlayson concludes that variation in the adult size is sufficient to embrace all the Central *lagotis*, it may be inferred that the ranges of the large western and smaller south-central races overlap to a far greater extent than previously supposed.

Whatever the identity of the Musgrave Ranges female, its relationships are complicated by specimens from Rawlinna, south-east Western Australia the dimensions of which intergrade perfectly with those of *sagitta* and *nigripes*, but having the extension of the vacuities and hind margin of the palate typical of the true *lagotis*; the adult male has the posterior extension of the nasalia about intermediate between *lagotis* and *sagitta*, and the female has the space between the nasalia and the inter-lachrymal line equaling that in *nigripes*. In both characteristics and geography, therefore, the Rawlinna specimens appear to represent a race intermediate between the central *sagitta* and the large western race, to which the Musgrave Ranges specimen apparently belongs.

Following on this intergradation of the western and central races, and progressing eastward, one notes the Gilles Plains, Eyres Peninsula, specimen listed by Wood Jones, the main cranial dimensions of which agree well with both the extreme western and eastern races of *lagotis*, and finally there is the Nalpa series, from south-east of Adelaide, with a basal length of skull greater than any other race.

Summary.

Analysis of the above appears to indicate that there is but one variable species of rabbit-bandicoot, excluding the much smaller and well characterised *leucura* and *minor*, ranging from inland New South Wales to coastal Western Australia, which is represented by several smaller intervening semi-desert races, with the extremes of east and west paralleling development to a striking degree. This construction is born out by a study of the C.S.I.R. Vegetation Map, which shows the intermediate Rawlinna specimens to inhabit desert-fringing country very similar to that four hundred miles eastward where *nigripes* occurs; the intervening desert areas, and smaller though intergrading forms, seeming effectively to separate the larger eastern and western races inhabiting the more fertile areas indicated on the map.

Though in some instances the extraordinary variability in the New South Wales crania is due to age, the varying conditions may be expected to occur in the smaller forms of intermediate range, thus involving their specific status. It is notable that the correct range of basal length of *nigripes* skulls is 72.5-81, according to the description, not 80-81, as tabulated in the Revision summary and listed in the Handbook. As a result of this alteration, the basal length of *sagitta* overlaps the *nigripes* minimum by 4 mm. The basal length of the slightly larger Rawlinna race intergrades with *nigripes*, but is smaller than the minimum measured for the typical south-western *lagotis*, though overlapping the minimum of young adults from New South Wales.

(6) Finlayson, Trans. Roy. Soc. South Austr., liv., 1930, 178.

It is also notable that Wood Jones' summary of specific characters shows the pes coloration tending to ally *sagitta* and *lagotis*, and that of the tail *sagitta* and *nigripes*, while the habits when in the burrow tend to ally the three forms.

In view of the puzzling intergradation and variability which apparently renders specific distinction impossible, it seems advisable to regard *sagitta* and *nigripes* as geographical races of *lagotis*, and to constitute new subspecies for the intervening and terminal eastern races, in the hope of defining their confusing interrelationship.

1. MACROTIS LAGOTIS LAGOTIS.

Perameles (Macrotis) lagotis Reid, Proc. Zool. Soc., 1837, 129-131. Swan River, south Western Australia.

Diagnosis.—A large race with a very long, comparatively sparse, silky coat, consisting mostly of underfur, the longer shining hairs being very sparse and soft. The colour of back near light mouse grey in the female, darker and more grizzled in the old male, darkened in the centre with brownish tipping, the whole suffused with a wash of the vinaceous buff which extends along the sides of the head and body and is warmest below the ear; on the hindquarters the buffy colour extends upwards over the hip, forming a stripe which is almost continuous with a buffy fringe of hair which extends across and along the base of the tail. Hair of face shorter and more woolly, the underfur paler, and a concentration of the brown colour on the centre and around the eyes. Fur of undersurface white to roots. Pes white above, dark sole-mark extending from heel to large pad. The black band of the tail usually longer than, or equalling, the white, well-haired and encircling the tail.

Skull large, basal length 87-94.8, opposed to 77-84.8 in nearest geographical race, the nasal width averaging less than in large allies, not exceeding 8 mm. Palatal margin extending well behind M4 in fully adult crania; the vacuities large, their hind margin extending beyond the front edge of M3. Teeth large, front of canine to back of M4 41-44, transverse width of M2 4.8-6.9 mm.

Considerably larger than the nearest geographical race at Rawlinna, on the edge of the Nullarbor Plain, but with a similar arrangement of the palate.

Habitat and Specimens Examined.—According to Shortridge in 1912, widely distributed over south and central Western Australia, eastward almost to a line with Kalgoorlie; extending to, or represented in, Central Australia, according to Finlayson. Specimens in the Australian Museum from Gracefield, by exchange with the Perth Museum; Coorigan, presented by Mr. A. S. Le Souef; Tenderden, collected by Messrs. E. Le G. Troughton and J. H. Wright. Type in British Museum.

2. MACROTIS LAGOTIS INTERJECTA, *subsp. nov.*

An intermediate race, somewhat smaller than the typical western one with which it is allied by palatal features, but with pes and cranial dimensions intergrading with the smaller races further to the east and centre. Fur shorter and more woolly than in typical race, the general colour more drab grey and less contrasting; fur of belly whitish to roots. Pes white above, the dark sole-mark extending to the large pad in the male and about half the distance in the female. Black portion of tail equalling, or shorter than, the white and completely encircling the shaft.

Hind margin of palate in adults extending well behind M4, and vacuities behind front margin of M3 as in typical race. Skull and teeth decidedly smaller; basal length 77-84.8, opposed to 87-94.8 in typical race, C-M4 34.8-38.7 against 41-44 mm.

Dimensions.—Allotype female and holotype male respectively (in the flesh): Head and body 303, 318; tail 207, 232; ear, from opening, 80, 82; pes 93, 98.5 mm.

Skull.—Basal length 77.7, 84.8; nasal length 37.8, 42.2; width 6.5, 7.5; palate length 52, 56.9; breadth outside M3 23.6, 23.7; front of canine to back of M4 34.8, 38.7; transverse width M2 4.1, 4 mm.

Habitat and Specimens.—Adult pair and young female from Rawlinna, Trans-Australian Railway, Western Australia, obtained in co-operation with Mr. A. S. Le Souef. The holotype and allotype registered M.4351 and M.4639 respectively, in the Australian Museum collection. It is possible that the Musgrave Ranges specimen recorded by Finlayson is an aged female of this race; cranial dimensions were unfortunately not given, but the pes length of 90 mm. is not reconcilable with the typical race (females 98-103), and allies it with the smaller more central ones.

Intermediate in size between its western ally and the small *sagitta*, and distinguished from *nigripes* by the white upper surface of the pes.

3. MACROTIS LAGOTIS NIGRIPES.

Thalacomys nigripes Wood Jones, Rec. S. Austr. Mus., ii., 3, 1923, 347-351, 3 figs. Around Ooldea Soak, Trans-Railway, South Australia.

An intermediate black-footed race, with dimensions intergrading with *interjecta* of the west side of the Nullarbor Plain, and *sagitta* of the more central region. General colour described as much as in true *lagotis*, being darker and more fawn-coloured immediately after the moult, and lighter and more silvery before; the body colour becomes darker upon the dorsal surface towards the rump, the tips of the long hairs posteriorly being black. Snout black from the naked portion to between the eyes, which are surrounded with black hairs. Ventral surface pure white. Tail with encircling black portion shorter than white. Manus black above the carpus and metacarpus, white over digits. From the ankle, the pes is entirely black above and below.

Skull fairly large, basal length 72-81, compared with 74-76.5 (*sagitta*) and 77-85 (*interjecta*); molar portion of palate slightly rounded but less than in *interjecta*, the breadth outside M3 averaging 20 opposed to 23.5 mm. Margin of palate extending well behind M4, but comparatively less than in typical race or *interjecta*; vacuities rather small, the hind border reaching to the anterior corner of M2. The molars were described as considerably smaller than those of *sagitta*, but the maximum length of C-M4 is the same, and barely 2 mm. less than this dimension in the somewhat larger *interjecta*.

Habitat.—All specimens examined by Wood Jones came "from a restricted area around Ooldea Soak," South Australia, on the east-west line, all being captured by aborigines around the Soak. Not uncommon.

Remarks.—Though this form is readily distinguished from all others by its black manus and pes, the intergrading of dimensions, variability of other features, and geographical location ally it with the other sub-desert races of *lagotis*. Females have not been examined; though the black manus and pes would doubtless prove consistent, the dimensions of females should further emphasise intergradation. The Ooldea district appears to possess a

fauna of its own, doubtless due to its rather unique situation on the fringe of the Nullarbor Plain, and the somewhat richer vegetation resulting from the presence of water in the region of the Soak.

4. *MACROTIS LAGOTIS SAGITTA*.

Thalacomys sagitta Thomas, Ann. Mag. Nat. Hist. (7), xvi., 1905, 426-7. Killalpaninna, east of Lake Eyre, South Australia.

The smallest race, but with the dimensions of pes, skull, and dentition intergrading with the sub-desert *nigripes* and *interjecta*. Regarding size, it is notable that Thomas, comparing it with typical *lagotis*, wrote that "Externally, apart from the corresponding difference in size, there is little to distinguish the two forms. On the whole, *Th. sagitta* is a little paler in tone, the black band on the tail is slightly shorter, being shorter instead of longer than the white end, and the feet are paler below, the black only extending about a third of their length underneath the heel."

Skull small, but basal length (74-76.5) and C-M4 (36-37) intergrading with those of *nigripes* (72-81 and 34.5-37 respectively). According to Wood Jones' specimens, the posterior portion of the palate is only slightly rounded and the molars are arranged in almost straight rows, diverging posteriorly; the posterior edge of the palate is described as terminating in line with M4, all of which features are reproduced in young adults of the extreme eastern and western races. Palatal vacuities apparently intermediate between *nigripes* and *interjecta*, their hind margin extending to about the mid point of M2.

Habitat.—Type locality Killalpaninna east of Lake Eyre; others from remains taken at Miller's Creek and Coward Springs (Wood Jones). This form was considered by Wood Jones to be restricted to the more arid central regions about the Lake Eyre basin and north towards Charlotte Waters. The C.S.I.R. Vegetation Map, however, indicates that a similar type of country extends south-west to the better type of country less than 100 miles north of Ooldea, thus bringing the race in contiguity with *nigripes*; the semi-desert area is shown due south to below Port Augusta, so that the range of *sagitta* may be, or have been, more extensive than supposed. It is possible that the Musgrave Ranges female may prove to be *sagitta*, thus considerably extending the range westward; the foot-length, however, equals that of the male holotype of *sagitta*, so that it may belong to the somewhat larger *interjecta*.

Remarks.—In view of the slender nature of the external characters, as recognised by Thomas, variability of cranial ones, intergradation of dimensions, and continuity of range with other sub-desert forms, there seems no doubt that *sagitta* represents a small desert race of the true *lagotis*, which attained its maximum size in the more fertile region south of Adelaide.

5. *MACROTIS LAGOTIS GRANDIS, subspecies nov.*

Diagnosis.—The largest race, the hind foot attaining a length of 114 mm., opposed to a maximum of 108 in an aged specimen of the typical western race, and 109.5 in a series of large and fully adult New South Wales males. Ears apparently much shorter in proportion to those of the small race, *sagitta*. Basal length also considerably larger in three skulls listed from Nalpa, from 103-105 mm., opposed to a maximum of 96 in the series of eastern and western races, and the large Lake Gilles specimen.

That the size is not merely individual is indicated by the nasal and palate lengths being very much in accord with the large specimens of the

next largest races; palatal vacuities therefore relatively very large, as they extend farther posteriorly than in the allied races, reaching quite to the centre of M3.

Habitat.—Nalpa, in the Lake Alexandrina District, south of Adelaide, South Australia.

Holotype.—Stuffed adult male in the Adelaide Museum from Nalpa, listed by Wood Jones as head and body 550; tail 260; hindfoot 114; ear 77 mm. Three paratype skulls with same data are listed by Wood Jones: a skull with intermediate C-M4 has the following dimensions:—greatest length 114; basal length 104; zygomatic breadth 56; nasals length 48; palate length 66; C-M4 44 mm.

Remarks.—A name has been afforded this apparently extinct race, with some hesitation, in view of the fact that differences noted doubtless reflect isolation in evidently favourable surroundings, the race therefore having an interesting bearing upon zoo-geographical distribution in southern Australia. It is significant in this regard, to note that one of the largest species of the widely ranging murine genus *Pseudomys* (*auritus*) was taken at Lake Albert in the same region.

In regard to the smaller foot length of the typical *lagotis*, it may be noted that Reid's measurement of 114 mm. evidently included the claw, thereby adding about 8 mm. to the usual measurement.

6. *MACROTIS LAGOTIS CAMBRICA, subsp. nov.*

Diagnosis.—A large race, paralleling the extreme western typical form in size and general characteristics, but much larger than the intervening inland sub-desert races. The fur is shorter, closer, and more woolly than that of the typical race; above, the general colour is more fuscous owing to the predominance of the darker buffy wash and brown tipping, over the bluish grey of the western race. Undersurface yellowish, instead of clear white. Black portion of tail equal to or longer than white; dark hairing on sole extending to the large pad.

The hind margin of palatal vacuities rarely more than just surpasses the anterior margin of M3. Molar rows crescentic, and hind margin of palate extending well behind M4 in old specimens, but the reverse condition, as described for *sagitta*, is shown in a young adult female. Nasals averaging wider than in typical *lagotis*, ranging from 7.3-10 against 6.8-8 mm., the relative maxima being in old specimens of similar basal length; Pm4 also averaging larger, the length, 3.8-4.5 against 3.6-3.9.

Dimensions.—Allotype female and holotype male respectively (stuffed): Head and body 390, 500; tail 248, 278; ear, from opening, 81, 93; hindfoot 98, 109.5 mm.

Skull.—Basal length 81, c96; nasal length 42, 48.9; width 7.7, 10; palate length 54, 64; breadth outside M3 24.2, 32.9; C-M4 39.3, 44.4; transverse width M2 4.8, 7 mm.

Habitat.—According to Museum specimens, originally distributed over inland New South Wales from the Darling River (Bourke) in the west, across to near the Great Dividing Range in the east (Bathurst and Goulburn), south to the Murray River and north to the Queensland border (Moree); probably extending into southern Queensland, as represented by the "typical living specimen from Queensland," referred to by Wood Jones.

Holotype and Allotype.—Adult male from Bathurst, No. M.677; young adult female from Coombie, in the area about midway between Hillston and Cobar, No. A.18,586, both in the Australian Museum collection.



Fig. 1.—Map of New South Wales, indicating the past range of the Bilby, *Macrotis lagotis cambrica*, indicating the localities where specimens in the Australian Museum were taken.

Localities.—Mossgiel, Coombie, Groongal, Narrandera, Illabo, Wallendbeen, Grenfell, Goulburn, Bathurst, Dubbo, Gilgandra, Bourke, Moree, Wellington caves (pleistocene).

Remarks.—This race, intermediate in size between its nearest western and southern neighbours, *sagitta* and *grandis*, has evidently been present in New South Wales for a very long time, according to its once wide distribution, and the fossil remains found at Wellington; Krefft remarked that the fossil teeth were larger and rather different to recent ones, but this may be discounted by his probably not being aware of the marked growth changes, and the remains may reasonably be taken as indicative of the long establishment of the local race.

7. MACROTIS MINOR.

Peragale minor Spencer, Proc. Roy. Soc. Vict. (n.s.), ix., 1897, 6, pl. ii. figs. 1-4.

Thalacomys leucurus Le Souef (not Thomas), Australian Zoologist, vi., 2, 1930, 110.

Diagnosis.—A small species which differs from *sagitta*, the smallest race of *lagotis*, in its definitely smaller size, coloration of the undersurface and

tail,* and different habits. Analysis of Spencer's description provides the following general characteristics.

Colour and Fur.—Fur very long, soft, and silky; composed almost entirely of underfur. General colour fawn-grey; apparently darker than *sagitta*, which Thomas described as a little paler than the typical western *lagotis*. On the back and sides the underfur is black basally, then fawn-coloured; the stouter hairs are very little longer than the underfur, and black-tipped. On the undersurface, the chin and inner side of the forelimbs are white; rest of limbs and undersurface grey, the fur with a dark grey basal part and white distal half. Manus white. Pes white above, the hairs on the posterior two-thirds of sole black, white anteriorly. Tail with proximal two-thirds short-haired and *black above*, final third white-haired and crested dorsally; sides and undersurface of tail with scanty stiff white hairs.

External Characters.—Size small, the head and body length not attaining 300 mm.; the tail relatively short as in *sagitta*, averaging about two-thirds the length of the remainder, instead of five-sixths as in *leucura*. Rhinarium naked but no backward prolongation on the snout as in *lagotis*. Hindfoot decidedly smaller than in *sagitta*, ranging from 57-73 in the typical series of adults of both sexes, against 91 mm. in the adult male type of *sagitta*. A small rounded pad at the base of the fourth toe and a much larger one at the base of the fifth. Mammae 8.

Skull and Dentition.—Skull smaller and more delicate than in *lagotis*, the basal length of an adult male is 66 mm. against 76.5 in the adult male type of *sagitta*, the smallest race of that species. The upper anterior extremity of the premaxillary not so strongly produced as in *lagotis*, the muzzle therefore not appearing so markedly trifid antero-laterally. According to Spencer's figure, the posterior end of the palate extends well behind M4, the hind margin of the nasals is separated by about 4 mm. from the line joining the lacrymal foramina, and the molar portion of the palate is slightly rounded. Posterior palatal vacuities extending from about the middle of Pm3 to the hind edge of M2. These features, derived from a single example, are doubtless subject to a considerable degree of variation, as indicated under the genus.

Molars small, in slightly curved rows, with considerable spaces between the lingual margins of adjacent teeth. Front of canine to back of M4 28 mm., against 36 in *sagitta*.

Comparison with Allies.—Apart from its size, which is intermediate between *leucura* and the smallest race of *lagotis*, this species is distinguished from both by having the basal half of the belly fur dark grey, instead of white or yellowish-white to the roots. According to the description, *minor* is further distinguished by having the black tail-mark on the dorsal surface only, instead of encircling the tail as in *lagotis*, while the entire tail of *leucura* is white.

The Mungerante Specimen.—This was, in my opinion, incorrectly recorded as *leucurus* by Le Souef, and I am indebted to Mr. Brazenor, of the National Museum, for the following points, derived from his manuscript notes, which tend to all the specimen with *minor*. The length of the head

* Since preparing the following description of *M. minor*, Mr. C. W. Brazenor, of the National Museum, Melbourne, has kindly examined the typical series and confirmed the distinctive characteristics of bi-coloured belly-fur, and restriction of black on the tail to a dorsal band.

and body suits the range given for *minor* and is considerably larger than that of *leucura*; that this is not merely due to age is shown by the relative shortness of the tail which agrees with *minor* in being about two-thirds the length of the head and body, instead of five-sixths as in *leucura*. A photo of the Mungeranie animal clearly shows the tail* to be parti-coloured, lack of which distinguishes *leucura*, while the brown mark on the posterior part of the sole agrees with *minor* rather than *leucura*, which is without dark hairing along the sole. The length of the skull (60 mm.), only 6 mm. less than listed for *minor*, and the length of C-M4, agree well with the latter, the size therefore being less than in *sagitta*, and considerably more than in *leucura*.

Distribution.—As only the typical series has been recorded, from the sandhills about forty miles to the north-east of Charlotte Waters, just north of the South Australian border, there is a tendency to regard *minor* as of a definitely more central range. As pointed out regarding *sagitta*, however, the range is probably more extensive than supposed, which is supported by the National Museum specimen, apparently reconcilable with *minor*, which comes from Mungeranie, east of Lake Eyre, only a little north of the type locality of *sagitta*.

Holotype and Allotype.—Only one specimen, adult male (e) of Spencer's list, has the skull removed, and this specimen, which is numbered R.12,430, with its skull as tabulated by Spencer, may definitely be designated as the holotype. Allotype, adult female (d) of Spencer's list, registered No. R.12,313. In the National Museum, Melbourne.

Remarks.—As was the view of Spencer, in which Thomas concurred, there can be little doubt of the specific distinction of *minor*, in support of which I now emphasise the restriction of the black on the tail to a dorsal band, and the bi-coloration of the belly-fur, characters not hitherto stressed, but, if consistent, serving to distinguish *minor* from all other forms. It is noteworthy that in his personal copy of the "Catalogue," which was thoughtfully placed at my disposal when working at the British Museum, Mr. Oldfield Thomas had pencilled "two specimens from Charlotte Waters, C.A., at once distinguished by tail black along top only for proximal half or two-thirds, in a narrow line or low crest, the sides dull whitish and the end of its long crest pure white." The feature was verified by the specimens, and it seems remarkable that its diagnostic importance was not stressed in Spencer's description.

Apart from differences of size and various features, the notes of Mr. Byrne, given by Spencer, showed the habits to differ from those of *sagitta*, and that this is recognised and exploited by the aborigines. The scanty white hairing of the undersurface of the tail, opposed to the thick encircling of dark hairs in *lagotis*, and the absence of the naked prolongation on the snout in the adult series, supports the inference of different diet and habits to those of the races of *lagotis*. As Thomas stated, *sagitta* is clearly the "Urgarta" which Spencer referred to the typical *lagotis*, in contrasting its habits and characters with those of *minor*, known to the aborigines as "Urpila."

The coincident range of the two forms, in conjunction with differences in size, characters, and habits, leaves no doubt of the specific distinction

* The dark dorsal band on the tail and the bi-coloured belly-fur are as in *minor*, but somewhat lighter, according to Mr. Brazenor.

from *lagotis sagitta*, but it is possible that *minor* may be subspecifically allied to *leucura*.

8. MACROTIS LEUCURA.

Peragale leucura Thomas, Ann. Mag. Nat. Hist. (5), xix., 1887, 397, and Cat. Mars. Monotr. Brit. Mus., 1888, 225, pl. ii. (animal), pl. xxi., figs. 9-10 (manus and pes).

Diagnosis.—Apparently the smallest of the genus, from all members of which it is distinguished by the wholly white tail, which is also proportionately longer, and by the wholly white pes which lacks a dark mark on the sole. Molars, according to Thomas, differing considerably from the true *lagotis*. Habitat: Central or North Central Australia.

Colour.—General colour uniform pale yellowish fawn. Top of head and back fawn, suffused with slaty grey, the hairs slate-coloured at the base and tipped with brown. Hairs of the muzzle, chin, chest, belly, limbs, and tail pure or yellowish white to the roots. Fore and hind limbs pure white, the pes without a dark mark along the sole.

External Characters.—Size small, form slender, the head and body length much smaller than that of females of *minor*, although the hindfoot almost equals the minimum for that series. Rhinarium hairless, but no naked prolongation on the snout. Tail proportionately very long, about five-sixths the length of the head and body; the hairs of the terminal third forming a prominent crest. Two small but distinct pads on the compound terminal projection opposite the 4th and 5th toes, closer and more like enlarged granules than those of *minor*.

Skull and Dentition.—Skull small and delicate compared with young *lagotis*, the general characters very similar, except that the bullae are more evenly hemispherical, and not so prominently bulbous postero-externally.

Teeth, according to Thomas, in comparison with an immature specimen of *lagotis* with unworn dentition, much smaller, but of similar shape and relative proportions. Molars small and quadrangular, their summits with numerous sharp-pointed cusps as in *Perameles*; their general structure therefore much more distinctly insectivorous than in *lagotis*; they also differ in the much earlier period at which they form roots, the roots of the two anterior molars being already formed and closed up in the very young holotype, while in *lagotis* the crowns are very long and the roots unclosed until quite late in life.

Comparison with Allies.—Although the holotype male was immature and the hindfoot-length approximates the minimum of females of *minor*, the nearest ally, it seems evident that *leucura* is distinguished by having the head and body proportionately smaller, the tail much longer, and by the coloration, in which the belly fur is uni-coloured, instead of bi-coloured, and the tail is wholly white instead of being black above for the dorsal two-thirds proximally; the wholly white pes also distinguishes it from all other species of the genus. Skull and dentition apparently smaller, and crowns of molars differing from those of *minor*.

Distribution.—The holotype, in the British Museum, was part of a small collection obtained from Mr. Beazley, then Museum Taxidermist in Adelaide. Though it was unfortunately unlocalised, Thomas stated that "other specimens in the collection belong either to North Australian species or to such as may have been obtained in the neighbourhood of Adelaide itself." As demonstrated in this paper, the small race *lagotis sagitta*, and *minor*, probably have a much larger range in south central Australia than

External and cranial dimensions of species and subspecies of the genus *Macrotritis*.

	<i>M. leucura</i> .		<i>M. minor</i> .		<i>Macrotritis lagotis</i> .					
	Holotype ♂ (in spirit), very young Central Austr.	♂ min. max. 200 240	♀ min. max. 118 152	♂ min. max. 245 270	<i>M. l. lagotis</i> . Gracefield, West Australia	<i>M. l. interjecta</i> . Rawlinna, Trans- Austr. Railway, West Australia	<i>M. l. nigripes</i> . Ooldea, Soak, Trans-Kiway, Sth. Australia	<i>M. l. sagitta</i> . Killaipainna, E. of Lake Eyre, Sth. Australia, Holotype ad. ♂	<i>M. l. grandis</i> . Nalpa Lake, Alexandrina Distr., South of Adelaide, Hltpc ♂, st.	<i>M. l. cambriaca</i> . New South Wales External dimensions of types; full series crania.
Head and body ...	142				ad ♀	Alltpe. ♀	Pte ♂	Hltpc ♂		Alltpe. ♀st. Hltpc ♂, st.
Tail ...	116				252	303	318	365	390	600
Ear ...	63		85	92	82	80	82	97	90	248
Hindfoot ...	55		62	65	73	93	98.5	96	98	81/88
<i>Skull</i> .										93/106
Basal length ...	45				full series, min. max. 87 94.8			72.5	81	full series, min. max. 81 96
Nasals, length ...	18				44.9	37.8	42.2	33	40	41.4
Nasals, gt. breadth	4.5				6.8	6.5	7.5	7	8	6.8
Intertemporal ...	10				11	11.5	13.4	12	13	12.1
Palate length	27.7				59	52	56.9	48	50	54
Palate, breadth outside M ³ ...					25	23.6	23.7	20	20	24.2
Palatal foramen ...	5.2				11 x 17	9.4 x 15	10 x 16	10	10	9.6 x 15
Front of canine— back of M ⁴ ...					41	34.8	38.7	34.5	37	38.3
Horizontal length of Pm ³ ...	3				4.2	3.8	4.1			3.8
Horizontal length of Pm ⁴ ...					3.6	3.3	3.7			3.6
Horizontal length of M ³ ...	10				13	11.8	13.3	12	13	13
Transverse width of M ² ...					4.8	4.1	4			4.7

supposed, so that it seems highly probable that *leucura* is the most northern representative of the genus. That it inhabits the more sandy central region is supported by the paler coloration, and possibly by the more insectivorous phase of the dentition, noted by Thomas; the body coloration may have been affected by long spirit preservation.

Remarks.—Apparently in conformity with their smaller size, the absence of a naked area back from the rhinarium suggests a similarity of habits and diet in *leucura* and *minor*, in which surface insects, in *leucura* at least, enter more generally than in *lagotis*. The restriction of the black on the tail of *minor* tends to support the affinity, so that it is just possible that additional material may ally the small forms subspecifically, though the comparative length of the tail of *leucura* is decidedly greater, being five-sixths as opposed to about two-thirds of the length of the head and body in *minor*; the bi-coloration of the belly fur and the white-haired sole further distinguish *leucura*.

It seems, however, in spite of the unsatisfactory nature of the unlocalised material, that there can be no doubt of the specific distinction of this small and very striking rabbit-bandicoot.

The molar structure probably confirms this separation in its approximation to that of *Perameles*, which was regarded by Lydekker as an indication that the Rabbit-Bandicoots were probably a specialised offshoot from that genus.
